MATHEMATICS 9th Science Group

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Chapter 9.

INTRODUCTION TO CO-ORDINATES GEOMETRY

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Contents

Coordinate Geometry

The study of geometrical shapes in a plane is called plane geometry. Coordinate geometry is the study of geometrical shapes in the Cartesian plane (coordinate plane).

Distance Formula

Let $P(x_1, y_1)$ and $Q(x_2, y_2)$ be two points in the coordinate plane where d is the length of the

line segment PQ. i.e. $|PQ| = d$ and given as

$$|d| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

EXERCISE 9.1

Q#1) Find the distance between the following pairs of points.

(a) $A(9,2), B(7,2)$

Sol: As given $A(9,2), B(7,2)$

Using distance formula

$$|d| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Put $x_1 = 9, x_2 = 7, y_1 = 2$ and $y_2 = 2$

$$|d| = \sqrt{(7-9)^2 + (2-2)^2}$$

$$|d| = \sqrt{(-2)^2 + (0)^2}$$

$$|d| = \sqrt{4}$$

$$|d| = 2$$

(b) $A(2,-6), B(3,-6)$

Sol: As given $A(2,-6), B(3,-6)$

Using distance formula

$$|d| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Put $x_1 = 2, x_2 = 3, y_1 = -6$ and $y_2 = -6$

$$|d| = \sqrt{(3-2)^2 + (2-2)^2}$$

$$|d| = \sqrt{(1)^2 + (0)^2}$$

$$|d| = \sqrt{1}$$

$$|d| = 1$$

(c) $A(-8,1), B(6,1)$

Sol: As given $A(-8,1), B(6,1)$

Using distance formula

$$|d| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Put $x_1 = -8, x_2 = 6, y_1 = 1$ and $y_2 = 1$

$$|d| = \sqrt{(6-(-8))^2 + (1-1)^2}$$

$$|d| = \sqrt{(6+8)^2 + (0)^2}$$

$$|d| = \sqrt{14^2}$$

$$|d| = 14$$

(d) $A(-4,\sqrt{2}), B(-4,-3)$

Sol: As given $A(-4,\sqrt{2}), B(-4,-3)$

Using distance formula

$$|d| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Put $x_1 = -4, x_2 = -4, y_1 = \sqrt{2}$ and $y_2 = -3$

$$|d| = \sqrt{(-4-(-4))^2 + \left(-3-\sqrt{2}\right)^2}$$

$$|d| = \sqrt{(-4+4)^2 + \left(3+\sqrt{2}\right)^2}$$

$$|d| = \sqrt{\left(3+\sqrt{2}\right)^2}$$

$$|d| = 3+\sqrt{2}$$

(e) $A(3,-11), B(3,-4)$

Sol: As given $A(3,-11), B(3,-4)$

Using distance formula

$$|d| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Put $x_1 = 3, x_2 = 3, y_1 = -11$ and $y_2 = -4$

$$|d| = \sqrt{(3-3))^2 + (-4-(-11))^2}$$

$$|d| = \sqrt{(0)^2 + (-4+11)^2}$$

$$|d| = \sqrt{(7)^2}$$

$$|d| = 7$$

(f) $A(0,0), B(0,-5)$

Sol: As given $A(0,0), B(0,-5)$

Using distance formula

$$|d| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Put $x_1 = 0, x_2 = 0, y_1 = 0$ and $y_2 = -5$

$$|d| = \sqrt{(0-0)^2 + (-5-0)^2}$$

$$|d| = \sqrt{(0)^2 + (-5)^2}$$

$$|d| = \sqrt{5^2}$$

$|d| = 5$

Q#2) Let P be the point on x-axis with x-coordinate a and Q be the point on y-axis with y-coordinate b as given below. Find the distance between P and Q.

(i) $a = 9, b = 7$

Sol: As Given $a = 9, b = 7$

$P(a, 0) = P(9,0)$ and $Q(0,b) = Q(0,7)$

Using distance formula

$|PQ| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$|PQ| = \sqrt{(0-9)^2 + (7-0)^2}$

$|PQ| = \sqrt{(-9)^2 + (7)^2}$

$|PQ| = \sqrt{81 + 49}$

$|PQ| = \sqrt{130}$

(ii) $a = 2, b = 3$

Sol: As Given $a = 2, b = 3$

$P(a, 0) = P(2,0)$ and $Q(0,b) = Q(0,3)$

Using distance formula

$|PQ| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$|PQ| = \sqrt{(0-2)^2 + (3-0)^2}$

$|PQ| = \sqrt{(-2)^2 + (3)^2}$

$|PQ| = \sqrt{4 + 9}$

$|PQ| = \sqrt{13}$

(iii) $a = -8, b = 6$

Sol: As Given $a = -8, b = 6$

$P(a, 9) = P(-8,0)$ and $Q(0,b) = Q(0,6)$

Using distance formula

$|PQ| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$|PQ| = \sqrt{(0-(-8))^2 + (6-0)^2}$

$|PQ| = \sqrt{(8)^2 + (6)^2}$

$|PQ| = \sqrt{64 + 36}$

$|PQ| = \sqrt{100} = 10$

(iv) $a = -2, b = -3$

Sol: As Given $a = -2, b = -3$

$P(a, 9) = P(-2,0)$ and $Q(0,b) = Q(0,-3)$

Using distance formula

$|PQ| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$|PQ| = \sqrt{(0-(-2))^2 + (-3-0)^2}$

$|PQ| = \sqrt{(2)^2 + (-3)^2}$

$|PQ| = \sqrt{4 + 9}$

$|PQ| = \sqrt{13}$

(v) $a = \sqrt{2}, b = 1$

Sol: As Given $a = \sqrt{2}, b = 1$

$P(a, 9) = P(\sqrt{2}, 0)$ and $Q(0,b) = Q(0,1)$

Using distance formula

$|PQ| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$|PQ| = \sqrt{(0-\sqrt{2})^2 + (1-0)^2}$

$|PQ| = \sqrt{(\sqrt{2})^2 + (1)^2}$

$|PQ| = \sqrt{2 + 1}$

$|PQ| = \sqrt{3}$

(vi) $a = -9, b = -4$

Sol: As Given $a = -9, b = -4$

$P(a, 9) = P(-9,0)$ and $Q(0,b) = Q(0,-4)$

Using distance formula

$|PQ| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$|PQ| = \sqrt{(0-(-9))^2 + (-4-0)^2}$

$|PQ| = \sqrt{(9)^2 + (-4)^2}$

$|PQ| = \sqrt{81 + 16}$

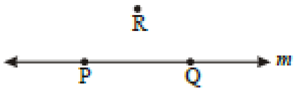
$|PQ| = \sqrt{97}$

Collinear or Non-collinear Points in the Plane

Two or more than two points which lie on the same straight line are called collinear points with respect to that line; otherwise they are called non-collinear.

Let m be a line, then all the points on line m are collinear.

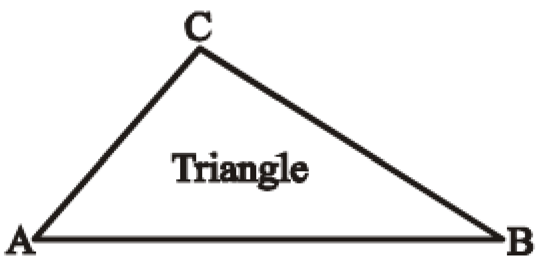
In the given figure, the points P and Q are collinear with respect to the line m and the points P and R are not collinear with respect to it.



Triangle

A closed figure in a plane obtained by joining three non-collinear points is called a triangle.

In the triangle ABC the non-collinear points $A, B\ and\ C$ are the three vertices of the triangle ABC. The line segments $AB, BC\ and\ CA$ are called sides of the triangle.



(i) Equilateral Triangle

If the lengths of all the three sides of a triangle are same, then the triangle is called an equilateral triangle .

(ii) An Isosceles Triangle

An isosceles triangle PQR is a triangle which has two of its sides with equal length while the third side has a different length.

(iii) Right Angle Triangle

A triangle in which one of the angles has measure equal to 90^0 is called a right angle triangle.

(iv) Scalene Triangle

A triangle is called a scalene triangle if measures of all the three sides are different.

Square

A square is a closed figure in the plane formed by four non-collinear points such that lengths of all sides are equal and measure of each angle is 90^o.

Rectangle

A figure formed in the plane by four non-collinear points is called a rectangle if,

(i) Its opposite sides are equal in length;

(ii) The angle at each vertex is of measure 90^o.

Parallelogram

A figure formed by four non-collinear points in the plane is called a **parallelogram** if

(i) its opposite sides are of equal length

(ii) its opposite sides are parallel

Let $P(x_1, y_1)$ and $Q(x_2, y_2)$ be any two points in the plane and $M(x, y)$ be a mid-point of points P and Q on the line-segment PQ is given as

$$Mid-point\ of\ PQ = M\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

EXERCISE 9.3

Q#1) Find the mid-point of the line segment joining each of the following pairs of points

(a) $A(9, 2), B(7, 2)$

Sol: As given $A(9, 2), B(7, 2)$

Using Mid-point formula

$$Mid-point\ of\ PQ = M\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

Put $x_1 = 9, x_2 = 7, y_1 = 2\ and\ y_2 = 2$

$$Mid-point\ of\ PQ = M\left(\frac{9 + 7}{2}, \frac{2 + 2}{2}\right)$$

$$Mid-point\ of\ PQ = M\left(\frac{16}{2}, \frac{4}{2}\right)$$

$$Mid-point\ of\ PQ = M(8, 2)$$

(b) $A(2, -6), B(3, -6)$

Sol: As given $A(2, -6), B(3, -6)$

Using Mid-point formula

$$Mid-point\ of\ PQ = M\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

Put $x_1 = 2, x_2 = 3, y_1 = -6\ and\ y_2 = -6$

$$Mid-point\ of\ PQ = M\left(\frac{2 + 3}{2}, \frac{-6 - 6}{2}\right)$$

$$Mid-point\ of\ PQ = M\left(\frac{5}{2}, \frac{-12}{2}\right)$$

$$Mid-point\ of\ PQ = M(2.5, -6)$$

(c) $A(-8, 1), B(6, 1)$

Sol: As given $A(-8, 1), B(6, 1)$

Using Mid-point formula

$$Mid-point\ of\ PQ = M\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

Put $x_1 = -8, x_2 = 6, y_1 = 1$ *and* $y_2 = 1$

$$Mid - point\ of\ PQ = M\left(\frac{-8+6}{2}, \frac{1+1}{2}\right)$$

$$Mid - point\ of\ PQ = M\left(\frac{-2}{2}, \frac{2}{2}\right)$$

$$Mid - point\ of\ PQ = M(-1, 1)$$

(d) $A(-4, 9), B(-4, -3)$

Sol: As given $A(-4, \sqrt{2}), B(-4, -3)$

Using Mid-point formula

$$Mid - point\ of\ PQ = M\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$$

Put $x_1 = -4, x_2 = -4, y_1 = 9$ *and* $y_2 = -3$

$$Mid - point\ of\ PQ = M\left(\frac{-4-4}{2}, \frac{9-3}{2}\right)$$

$$Mid - point\ of\ PQ = M\left(\frac{-8}{2}, \frac{6}{2}\right)$$

$$Mid - point\ of\ PQ = M(-4, 3)$$

(e) $A(3, -11), B(3, -4)$

Sol: As given $A(3, -11), B(3, -4)$

Using Mid-point formula

$$Mid - point\ of\ PQ = M\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$$

Put $x_1 = 3, x_2 = 3, y_1 = -11$ *and* $y_2 = -4$

$$Mid - point\ of\ PQ = M\left(\frac{3+3}{2}, \frac{-11-4}{2}\right)$$

$$Mid - point\ of\ PQ = M\left(\frac{6}{2}, \frac{-15}{2}\right)$$

$$Mid - point\ of\ PQ = M(3, -7.5)$$

(f) $A(0, 0), B(0, -5)$

Sol: As given $A(0, 0), B(0, -5)$

Using Mid-point formula

$$Mid - point\ of\ PQ = M\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$$

Put $x_1 = 0, x_2 = 0, y_1 = 0$ *and* $y_2 = -5$

$$Mid - point\ of\ PQ = M\left(\frac{0+0}{2}, \frac{0-5}{2}\right)$$

$$Mid - point\ of\ PQ = M\left(\frac{0}{2}, \frac{-5}{2}\right)$$

$$Mid - point\ of\ PQ = M(0, 2.5)$$

REVIEW EXERCISE

Q#2) Answer the following, which is true and which is false.

(i) A line has two end points…F …..

(ii) A line segment has one end point…F …..

(iii) A triangle is formed by three collinear points. …F

(iv) Each side of a triangle has two collinear vertices…T…

(v) The end points of each side of a rectangle are collinear…T ….

(vi) All the points that lie on the x-axis are collinear…T …

(vii) Origin is the only point collinear with the points of both the axes separately. …T..

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